

Claims

1. A backprojection unit (37) adapted for backprojecting
5 pixel data of n acquired projections (53) onto a voxel sub-
volume (58), with n being a natural number, wherein said
backprojection unit (37) comprises for each of the n projec-
tions:
 - voxel center determination means adapted for projecting m
10 contiguous voxels onto a respective one of the projections,
with m ≥ 2 being a natural number, thus obtaining m pro-
jected voxel centers (62, 63, 64, 65) per projection;
 - memory access means adapted for fetching, for each of the m
15 projected voxel centers, pixel data of pixels adjacent to
the projected voxel center from a respective projection
buffer (50);
 - multiplexing means (70) adapted for distributing the
fetched pixel data to m different pipelines (38, 39, 40,
41).
- 20 2. The backprojection unit according to claim 1, further com-
prising n projection buffers, with each of the projection
buffers being adapted for storing pixel data of one of the n
projections.
- 25 3. The backprojection unit according to claim 2, wherein each
of the projection buffers comprises at least (2m+2) different
memory banks.
- 30 4. The backprojection unit according to claim 3, wherein the
memory access means are adapted for accessing some of the at
least (2m+2) memory banks of the corresponding projection
buffer in parallel.
- 35 5. The backprojection unit according to claim 1 or any one of
the above claims, wherein pixel data of neighboring pixels
are stored in different memory banks.

6. The backprojection unit according to claim 1 or any one of the above claims, wherein a respective memory bank a pixel is stored in is selected by means of a multidimensional index,
5 wherein the multidimensional index is derived from the pixel coordinates (x, y).
7. The backprojection unit according to claim 1 or any one of the above claims, wherein a two-dimensional index (u, v) derived from the pixel coordinates (x, y) is used for selecting
10 a respective one of the memory banks.
8. The backprojection unit according to claim 7, wherein, for m = 4, the two-dimensional index (u, v) is determined as (u, v) = (x mod 5, y mod 2).
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9. The backprojection unit according to claim 1 or any one of the above claims, wherein at least one of the pipelines comprises:
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 - pixel data interpolation means adapted for performing a bilinear interpolation of the pixel data of pixels adjacent to a respective projected voxel center, in order to obtain an interpolated pixel value at the respective projected voxel center.
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10. The backprojection unit according to claim 9, wherein at least one of the pipelines further comprises:
 - a weighting unit adapted for weighting the interpolated pixel value at the projected voxel center with the inverse square of the distance between voxel and source, in order to obtain a weighted pixel value at the projected voxel center.
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11. The backprojection unit according to claim 10, wherein at least one of the pipelines further comprises:

- an adder unit adapted for adding the weighted pixel value at the projected voxel center to voxel data of the corresponding one of the m contiguous voxels.
- 5 12. The backprojection unit according to claim 11, wherein the weighted pixel values are added to the contents of storage cells that belong to m different shift registers.
- 10 13. The backprojection unit according to claim 1 or any one of the above claims, wherein voxel data of the m contiguous voxels is stored in storage cells of m shift registers, said shift registers being adapted for accumulating the contributions of the n projections.
- 15 14. The backprojection unit according to claim 12 or claim 13, wherein each of the m shift registers comprises n storage cells that correspond to the n different projections.
- 20 15. The backprojection unit according to claim 12 or any one of the above claims, wherein, after voxel data stored in the m shift registers has been updated, the contents of the shift registers are shifted by one position in order to consecutively process the contributions of the n different projections.
- 25 16. The backprojection unit according to claim 1 or any one of the above claims, wherein the voxel subvolume is a slice of a voxel volume.
- 30 17. The backprojection unit according to claim 16, wherein the slices are oriented perpendicular to an axis of rotation that has been used for acquiring the projections.
- 35 18. The backprojection unit according to claim 1 or any one of the above claims, wherein a voxel volume is initially segmented into a plurality of columns, with each voxel subvolume being a slice of a respective column.

19. The backprojection unit according to claim 1 or any one
of the above claims, wherein the backprojection unit is im-
plemented as a hardware unit, in particular by means of a
5 Field Programmable Gate Array (FPGA).
20. A method for backprojecting pixel data of n acquired pro-
jections (53) onto a voxel subvolume (58), with n being a
natural number, the method comprising the following steps
10 that are carried out for each of the n projections:
- projecting m contiguous voxels onto a respective one of the
projections, with $m \geq 2$ being a natural number, thus ob-
taining m projected voxel centers (62, 63, 64, 65) per pro-
jection;
15 - fetching, for each of the m projected voxel centers, pixel
data of pixels adjacent to the projected voxel center from
a respective projection buffer (50), and
- distributing the fetched pixel data to m different pipe-
lines (38, 39, 40, 41).
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21. The method according to claim 20, wherein the pixel data
of the n projections are stored in n separate projection
buffers.
- 25 22. The method of claim 20 or claim 21, wherein the step of
fetching comprises accessing at least some of the at least
(2m+2) memory banks in parallel.
- 30 23. The method of any of claims 20 to 22, further comprising
a step of selecting a respective memory bank by means of a
multidimensional index that is derived from the pixel coordi-
nates (x, y).
- 35 24. The method of any of claims 20 to 23, further comprising
a step of selecting a respective memory bank by means of a
two-dimensional index (u, v) that is derived from the pixel
coordinates (x, y).

25. The method of any of claims 20 to 24, further comprising
a step of performing a bilinear interpolation of the pixel
data of pixels adjacent to a respective projected voxel cen-
5 ter, in order to obtain an interpolated pixel value at the
respective projected voxel center.
26. The method of claim 25, further comprising a step of
weighting the interpolated pixel value at the projected voxel
10 center with the inverse square of the distance between voxel
and source, in order to obtain a weighted pixel value at the
projected voxel center.
27. The method of claim 26, further comprising a step of add-
15 ing the weighted pixel value at the projected voxel center to
voxel data of the corresponding one of the m contiguous vox-
els.
28. The method of any of claims 20 to 27, further comprising
20 a step of accumulating the contributions of the n projections
by means of m shift registers, whereby each of the m shift
registers comprises n storage cells that correspond to the n
different projections.
- 25 29. The method of claim 28, further comprising a step of
shifting the contents of the m shift registers by one posi-
tion, after voxel data stored in the m shift registers has
been updated, in order to consecutively process the contribu-
tions of the n different projections.
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30. The method of any of claims 20 to 29, Wherein slices of a
voxel volume are chosen as voxel subvolumes, with the slices
being oriented perpendicular to an axis of rotation that has
been used for acquiring the projections.
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31. The method of any of claims 20 to 30, further comprising
a step of initially segmenting a voxel volume into a plural-

ity of columns, with slices of said columns being chosen as voxel subvolumes.

32. The method of claim 31, wherein a separate backprojection
5 is performed for each slice of the column.

33. Computer program product, comprising computer program means adapted to embody the features of the backprojection unit as defined in anyone of claims 1 to 18 when said computer
10 program product is executed on a computer, digital signal processor, or the like.

34. Computer program product, comprising computer program means adapted to perform the method steps as defined in any-
15 one of claims 20 to 32 when said computer program product is executed on a computer, digital signal processor, or the like.